

IBM Technical Papers Published in Other Journals

Analyzing Relay Networks, R. E. Markle, *Electrical Manufacturing*, pp. 124-129 (September 1956).

A mathematical derivation is first made, and then the principle is applied to a number of inductive circuits. The principle is used to explain the release delays of a relay in parallel with a resistor or other relays. Computations are also made of circuits with mutual inductance. A means of handling nonlinear inductance is also explained, as well as calculations of energy changes required in order for the principle to be true. The principle is finally used to design a circuit to produce an instantaneous change in flux in a relay coil to decrease the operating time of the relay.

Anomalous Lorenz Numbers in Mixed Semiconductors, P. J. Price, *Proceedings of the Physical Society of London*, **69 B**, 851 (August 1956).

A new evaluation of Goldsmid's data on the thermal conductivity of Bi_2Te_3 is made. Agreement with the "ambipolar" theory is found. The case of thermal conduction in InSb is discussed. It is pointed out that neither ambipolar transfer nor, in its most obvious interpretation, exciton transfer can account for Busch and Schneider's data. It is suggested that the anomaly for InSb may be associated with transfer by plasma modes.

The Application of Temporal Correlation Techniques in Psychology, C. A. Bennett, W. J. Merrill, Jr., *The Journal of Applied Psychology*, **40**, No. 4, 272-280 (August 1956).

Definitions and computation procedures for various temporal correlation techniques are presented. These techniques include serial correlations for discrete data and correlation functions for continuous data. Specifically described are auto-correlations for temporal relatedness within one series of data, and cross correlations for such relatedness between two series. These techniques are appropriate for both cyclical and non-cyclical temporal phenomena. Various applications of temporal correlation techniques within psychology are described.

Design of Cam Followers, Martin Kloomok, R. V. Muffley, *Product Engineering*, p. 197 (September 1956). This is the fifth article in a series, which includes:

Selecting the Cam Profile (February 1955); **Determining the Maximum Pressure Angle** (May 1955); **Calculating the Minimum Radius of Curvature** (September 1955); **Evaluating Dynamic Loads** (January 1956); and **The Application of Digital Computers** (to be published in January 1957).

The following is an abstract of the current (fifth) article:

There are special bearing problems which arise in a cam follower, particularly the stress situation in the outer race of an anti-friction bearing. Tables of allowable bearing loads are given for several types of bearings and loading conditions. A simplified method for determining the contact stress is presented in nomographic form and tabular design data are given for steels commonly used in cams.

Effect of an Electrical Field on the Transitions in Single Crystals of Barium Titanate, E. J. Huibregtse, *Ceramic Industry*, **67**, 93 (July 1956).

In 1953 Merz published a paper on the change of the Curie temperature in BaTiO_3 due to an electric field, and the resulting double loops when he observed the polarization against large electric fields. From his double loops, he obtained coefficients for a mathematical expansion for the free energy of BaTiO_3 , which had been proposed by Devonshire.

Experimental results have been evaluated in the light of the Devonshire function, which is applicable to the tetragonal and orthorhombic states, and good agreement has been achieved.

Electric Field Effect on the Tetragonal Orthorhombic Transition in Barium Titanate, E. J. Huibregtse, D. R. Young, *Physical Review*, **103**, 1705-1711 (September 1956).

The effect of an electric field on the transition between the orthorhombic and tetragonal states in single crystals of BaTiO_3 has been investigated. With zero bias the tetragonal-to-orthorhombic transition occurs near 5°C and the inverse transition at 11°C , exhibiting a temperature hysteresis of about 6°C . The dielectric constant has been measured as a function of temperature and as a function of field at fixed temperatures. Transitions between states are sharp (first order), whether the transition is produced by varying the temperature or the electric field, provided the broad area sides are completely electroded.

The Electron Work Functions of the Elements, Herbert B. Michaelson, *Handbook of Chemistry and Physics*, 38th Edition, Chemical Rubber Publishing Co., pp. 2350-58 (July 1956).

Compilation of work function data, expressed in electron volts, for 58 elements; values include those obtained by the thermionic, photoelectric and contact potential methods. An extensive bibliography is included.

Engineering Design of a Magnetic-Disk, Random-Access Memory, T. Noyes, W. E. Dickinson, *Proceedings of the Western Joint Computer Conference*, 1956, pp. 42-44.

The design features are described of a new large-capacity memory device having random access to information stored magnetically on rotating disks. The mechanical arrangement of an array of 50 disks is shown, and details are given of the pair of magnetic recording heads, which are spaced accurately from the disk surface by air jets. The access mechanism and the timing system for positioning the heads on the disk tracks are described. The total storage capacity of the system is 5,000,000 alphanumeric characters.

Hall Effect and Conductivity in Porous Media, R. Landauer, J. A. Swanson, H. J. Juretschke, *Journal of Applied Physics*, **27**, 838-839 (July 1956).

This letter is concerned with materials which have a uniform conductivity σ_0 , and a uniform local Hall constant R_0 , except for the presence of nonconducting pores or cavities. Pore fields have been evaluated in a number of cases, using the boundary conditions that the normal current into the pore vanishes and that the potential is continuous. Four results are stated.

Lattice Parameters of Zn_3As_2 , H. Cole, F. W. Chambers, H. M. Dunn, *Acta Crystallographica*, **9**, 685 (August 1956).

Rotation and precession data taken using a single crystal of Zn_3As_2 indicate a body-centered-tetragonal unit cell. Lattice parameters obtained from spectrometer measurements on a single crystal with faces cut perpendicular to (001) and (100) give $c = 11.78\text{\AA}$.

The Logical Design of a Digital Computer for a Large-Scale Real-Time Application, M. M. Astrahan, B. Housman, J. F. Jacobs, R. P. Mayer, W. H. Thomas; *Proceedings of the Western Joint Computer Conference*, 1956, pp. 70-77.

Special design features and performance criteria are described for the logical system in the digital computer used in the SAGE (Semi-Automatic Ground Environment) air defense system. Design details are given for the arithmetic element, high-speed multiply, index registers, input-output control, and magnetic drum buffer. The system is designed according to special military application requirements of speed, capacity, reliability and flexibility.

Magnetic Recording Head Design, A. S. Hoagland, *Proceedings of the Western Joint Computer Conference*, 1956, pp. 26-31.

An analysis of the process of magnetic recording of digital data is presented from which qualitative magnetic head design concepts are developed and their usefulness demonstrated, both in the evaluation of magnetic head structures and in design for high density storage. This work was undertaken in connection with the development of the IBM 305 random access memory unit. The performance of the selected head design under the nominal operational conditions of a 1-mil spacing, 2-mil gap, and a 1-mil recording surface layer is the following: a 13-mil base-line pulse width voltage response for a saturation step function of writing current.

Materials and Design Factors in Printed Wiring Applications — Part I, W. H. Klippel, E. J. Lorenz, *Electrical Manufacturing*, **58**, 62-69 (July 1956).

In most instances a printed wiring board consists of a dielectric material with a metallic foil bonded to one or both sides. The best known combination is the copper-clad laminate. This article discusses the inherent properties of base laminates and copper foil, appropriate tests and specifications, and related design considerations.

Materials and Design Factors in Printed Wiring Applications — Part II, W. H. Klippel, E. J. Lorenz, *Electrical Manufacturing*, **58**, 91-95 (August 1956).

This article highlights problems in batch variations in properties of printed wiring board materials, in tooling, and in processing. Several solutions, gained from actually producing printed wiring boards, are discussed.

A Molded Flush Circuit Process, R. M. Bell, *Western Plastics*, **3**, No. 18, 17-18 (August 1956).

A specific process for molding flush circuits has recently been developed and put into production. The object of this process is to provide a printed type conductor that is flush with the insulating backing. This paper discusses the preparation of the metal foil and describes in detail the method of securing a satisfactory bond between the plastic and the foil. This process may be applied to concave or convex shapes of reasonable complexity, limited only by plastic molding design and techniques. Through holes may be molded, eliminating the costly operation of drilling. Several applications are also discussed.

Polarization Reversal in the Barium Titanate Hysteresis Loop, R. Landauer, D. R. Young, M. E. Drougard, *Journal of Applied Physics*, **27**, 752-758 (July 1956).

In the presence of an opposing field the polarization of tetragonal BaTiO_3 reverses itself. Devonshire's phenomenological treatment shows that in a sufficiently large opposing field the original direction of polarization becomes unstable. The values of commonly observed coercive fields are much smaller than this, and the polarization actually reverses while the initial state is still metastable. The absence of an appreciable inductive component in the small signal conductivity measurements indicates that variations in the applied field produce corresponding variations in the switching current with a time lag which is at most a few times 10^{-8} second and possibly much less. The increases in dielectric constant measured during switching remain unexplained.

Reactions of the Group VB Pentoxides with Alkali Oxides and Carbonates, A. Reisman, F. Holtzberg, M. Berkenblit, M. Berry, (Thermal and X-ray Phase Diagrams of the System K_2O or K_2CO_3 with Ta_2O_5 .) *Journal of the American Chemical Society*, **78**, 4514 (September 20, 1956).

The phase diagram of the system K_2O or K_2CO_3 has been determined using differential and conventional thermal analysis, optical pyrometry, and x-ray techniques. Four compounds have been characterized and their melting points determined. The polymorphism of Ta_2O_5 has been reinvestigated from room temperature to its melting point. Derivation from the Goldschmidt theory of model systems has been observed.

Tests on a Cell Assembly Theory of the Action of the Brain, Using a Large Digital Computer, N. Rochester, L. H. Haibt, W. L. Duda, J. H. Holland, *IRE Transactions on Information Theory*, **I**, T-2, 80-93 (September 1956).

Theories by D. O. Hebb and P. M. Milner on how the brain works were tested by simulating neuron nets on the IBM Type 704 Electronic Calculator. The formation of cell assemblies from an unorganized net of neurons was demonstrated, as well as a plausible mechanism for short-term memory and the phenomena of growth and fractionation of cell assemblies. The cell assemblies do not yet act just as the theory required, but changes in the theory and the simulation offer promise for further experimentation.

Trapped Flux in Superconductive Tin, J. I. Budnick, E. A. Lynton* and B. Serin*, *Physical Review*, **103**, 286 (July 15, 1956).

The percentage of trapped flux was measured in cylindrical tin samples containing antimony, bismuth, or indium, with particular regard to the effect of annealing. The flux was trapped by the application and removal of a large transverse magnetic field. The results do not confirm Pippard's conclusion that a marked change in flux trapping behavior occurs at a critical concentration of impurity. Instead, all samples, whether of high- or of low-impurity concentration, followed the same behavior, namely, that the percentage of trapped flux rises steeply near the transition temperature, and that this rise decreases monotonically with annealing time. In all cases in which this rise is discernible its temperature dependence is linear with the function $(1 - t^4)^{-1/2}$ up to $t \geq 0.98$, where $t = T/T_c$. Evidence indicates that the binary specimens used by us as well as those used by Pippard have a substructure of filaments of different concentrations, which trap flux when the sample is insufficiently annealed.

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